

**FINAL REPORT DARPA CONTRACT # DAA HOI-98-P-R010**  
**JUNE 16, 1998**

**ADVANCED CERAMETRICS, INC**

This report covers the period between the completion of SBIR Phase I contract # DAA-HOI-97-C-R114 and Phase II SBIR contract # DAA-HOI-98-C-R107. This effort was expended, in response to contract # DAA-HOI-98-P-R010. The general purpose of this work was to begin preparation for the above Phase II SBIR ahead of actual award so that the two year Phase II period could be more effectively completed. Advanced Cerametrics, Inc (ACI) determined that certain improvements were necessary to be made to its ceramic fiber spinning equipment in order to make the types and quantities of PZT fiber required for the Phase II effort. Several pieces of equipment were ordered and installed on the spinning machine. Several spinning trials were run and samples were sent to ACI's subcontractors.

ACI subcontractor, Mide Technology Corp. produced sample PZT fiber composites using interdigitized electrodes. An average of 550 micro-strain was achieved using 3,000 volts. This equates to a 0.005" elongation of a 6" long strip. This value will be used as a baseline for the Phase II work. Future efforts will be aimed at increasing the force while reducing the voltage. Fiber straightness and proximity of the electrode are key.

ACI's subcontractor, Composite Systems Design (CSDI), worked on its newly designed and constructed PZT fiber "paper making" equipment. No experiments were run. A summary report from CSDI is enclosed for reference.

The Phase II SBIR, as above, was negotiated and signed at the end of May. The work begun in this bridge contract will continue seamlessly into the Phase II and, as intended, this bridge has sped the development work so that pre-commercial devices should be available before the conclusion of the Phase II.

ACI is grateful for the support provided through this bridge grant and, hopefully, the results so far and those that are anticipated will be justification of the cost.

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**PROGRESS REPORT 5/31/98**  
**COMPOSITE SYSTEMS DESIGN**  
**Peter Ogle**

Work has been focused on the demonstration of the paper making process to make a directional paper from the piezoelectric fiber provided by ACI. For this initial demonstration, the paper making will be performed by drawing paper slurry through a screen. The slurry is a mixture of a small amount of fiber and binder in a large amount of water. A directional orientation of the fiber in the paper will be achieved through a transitional motion of the slurry as it passes through the screen. The test should help define the best composition of the slurry, the degree of transitional motion of the slurry relative to the screen necessary to achieve the desired directionality and the preferred fiber length. Also of importance will be the determination of the screen mesh size and procedures for drying and removing the paper from the screen. This test cell should be able to make a strip of paper that is two inches wide in a ring that is ten inches in diameter. The ring shape was selected to facilitate the generation of the relative motion between the slurry and the screen. The size was selected to enable cutting of actuator specimens of approximately 1" x 4" with a relatively uniform fiber direction (circumferential).

During the past month, the paper making demonstration cell was designed and the necessary equipment was procured. All elements of the cell have arrived with the exception of the filter screen. The screen is expected in the first week of June. Assembly of the equipment is nearly complete. The vacuum pump provided by ACI will be used draw the slurry through the screen. Also, a small amount of polyvinyl alcohol has been purchased to be used as the binder for the slurry.

**Planned activities for period 6/1-6/30/98**

Assembly of the demonstration test cell should be completed and initial testing should be underway. Plans are to use chopped fiberglass for initial evaluation of the process. Subsequent test will use the 1.5 oz. of unsintered 20 micron fiber samples that ACI has provided. The cell will use approximately one ounce of fiber for each trial so an additional 5 oz will be needed in June and at least 10m oz in July. Also needed in July will be at least 5 oz of sintered fiber.

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	16 JUNE 98	FINAL      1 APRIL-16 JUNE 1998
4. TITLE AND SUBTITLE		5. FUNDING NUMBERS
PZT CERAMIC FIBER PROCESS FOR HIGH PERFORMANCE ACTUATORS		C DAA-H01-98-P-R010
6. AUTHOR(S)		
JONATHAN D. FRENCH, PH.d.		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER
ADVANCED CERAMETRICS, INC. P.O. BOX 128 LAMBERTVILLE, NJ 08530-0128		ACI 0001
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY ATTN: DSO (DR. WALLACE A. SMITH) 3701 NORTH FAIRFAX DRIVE ARLINGTON, VA 22203-1714		
11. SUPPLEMENTARY NOTES		
N/A		
12a. DISTRIBUTION / AVAILABILITY STATEMENT		12b. DISTRIBUTION CODE
OPEN DISTRIBUTION		
13. ABSTRACT (Maximum 200 words)		
ADVANCED CERAMETRICS DESIGNED IMPROVED PROCESSING PROCEDURES FOR ITS PIEZOELECTRIC PZT CERAMIC FIBER SPINNING PROCESS. THE NECESSARY EQUIPMENT WAS PURCHASED AND INSTALLED. SAMPLE ACTUATORS WERE BUILT USING LARGE DIAMETER PZT FIBERS WHICH ACHIEVED MICROSTRAIN VALUES EQUIVALENT TO ACTIVE STRUCTURES USING PZT MICRO-RODS. INITIAL TESTS ON A "PAPER MAKING" PROCEDURE TO MAKE FIBER BASED ACTUATORS WERE CONDUCTED.		
14. SUBJECT TERMS		15. NUMBER OF PAGES
DEVELOPMENT OF IMPROVED PROCEDURES TO MAKE PIEZOELECTRIC CERAMIC FIBERS FOR ACTIVE STRUCTURES		3
16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
20. LIMITATION OF ABSTRACT		